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Development of Nipple Suckling Preference in Infant Japanese Macaques (*Macaca fuscata*)

ニホンザル乳児の授乳時における乳首の選好性について

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Abstract

Infants of several primate species show nipple preference in their youth. Little is known, however, about when and how the laterality in nipple preference develops. I observed and analysed nipple suckling behavior in infant Japanese macaques (*Macaca fuscata*) to identify factors which influence laterality in nipple preference. I observed four mother-infant pairs in Arashiyama Monkey Park. I recorded the infants' nipple suckling behavior and the lying down posture of the mothers, as well as their activities as mother-infant pairs. Three of the four pairs showed the development of significant nipple preference during 10–15 days of age of the infant. Contrary to expectations, activities performed by the mother, such as grooming, moving, sitting, lying down, and feeding, did not appear to affect infant nipple preference. These results suggest that nipple preference may be fixed at 10–15 days of age, although it is likely to be influenced by the difference in milk secretion between nipples or laterality of the mother's hand when supporting an infant. Longer and more intensive observations are required to answer these questions.

Key words: Japanese macaque, *Macaca fuscata*, Laterality, Nipple Preference, Infant

要旨

霊長類において、授乳時に乳児が咥える乳首の頻度が左右で偏るという例がいくつか報告されているが、そのような選好性がいつ、どのような要因によって決定されるのかについては不明な点が多い。本研究ではニホンザルを対象に、乳児が咥える乳首の偏りとそれを決める要因を明らかにすることを目的に調査、考察を行った。嵐山モンキーパークで生まれた4組の親子を対象に観察を行い、乳児が咥える乳首、母親の寝る向き、親子の行動を記録した。その結果、観察できた4組のうち3組の親子で、生後10日から15日間の間に乳児の咥える乳首が固定していくということが分かった。座る、移動する、グルーミングなどの母親の行動には乳児が咥える乳首と関係があると予想されたが、実際にはそのような関係性は確認できなかった。授乳の際の乳首の選好性を明らかにするために、母乳の分泌量や乳児を抱くときの手の左右性を観察するなどさらなる

る検証が必要である。

重要語句: ニホンザル、左右性（側性）、授乳、選好性、乳児

Introduction

How do infants develop nipple preference? Why do humans exhibit preference and laterality in suckling? I wanted to make a comparison among primates to elucidate the evolution of nipple preference. In the case of chimpanzees (*Pan troglodytes*), most chimpanzee infant-mother pairs showed left nipple preference. It is likely that the preference is facilitated by the tendency of mothers to support their neonates with their left arm (1). Among golden snub-nosed monkeys (*Rhinopithecus roxellana*), neonate nipple preference has been shown to not be significantly correlated with maternal cradling laterality (2). Rhesus macaque (*Macaca mulatta*) infants, show a significant preference for one nipple over the other after 48 hours (3). Infant Japanese macaques (*Macaca fuscata*) have also been reported to show nipple preferences in their suckling behavior (4). There is, however, little data to help determine when and how infants develop their nipple suckling preferences. I conducted field research to clarify the factors that affect nipple preference in Japanese macaques by observing mother-infant pairs in Arashiyama Monkey Park.

Materials & Methods

Study site, period, and subjects

I observed mother-infant pairs among provisioned Japanese macaques in Arashiyama Monkey Park “Iwatayama” (Table 1). The macaques in the park are well habituated so that I could observe them without disturbing at close distances. I conducted field research on May 16th, 30th, and June 6th in 2015. The total observation time was 10 h.

I observed four mothers (*Kusha-01*, *Cooper-11*, *Rakushi-06* and *Chonpe-94*) and their infants born during the latest birthing season (*Kusha*: 29/4/2015; *Cooper*: 12/5/2015; *Rakushi*: 14/5/2015; *Chonpe*: 21/5/2015).

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Data sampling

I observed mother-infant pairs using the focal animal sampling method (5). I followed each pair for 130 min before switching to another pair sequentially. All focal pairs were observed at least once during each observation day. I collected data using the one-zero sampling method (6). I divided a recording session into one minute intervals and recorded which nipple the infant suckled (it can be neither, left, right, or both nipples) during the interval. The kind of activity that the mother performed during that session, such as grooming, sitting, lying, moving, and others was also recorded. The infant's behavior was recorded as far as I could see by *ad libitum* sampling (6).

Table 1. Description of subject pairs.

	Birthday of infants	Childbirth experience
<i>Kusha-01</i>	29/4/2015	Second
<i>Cooper-11</i>	12/5/2015	First
<i>Rakushi-06</i>	14/5/2015	First
<i>Chonpe-94</i>	21/5/2015	Second or more

Data analysis

In order to determine laterality in nipple preference, I used two different analytical methods and compared the difference between nipples that the infant suckled from the viewpoint of either the infants' growing period or mothers' postures. For both methods, I divided the number of sampling sessions during which each activity was observed by the total number of sampling sessions. This means that I regarded every instance of a given activity that occurred within a one-minute interval as one instance and every minute as one score; I ignored the duration of the activity for and how many times the activity was repeated in a given sampling session.

For the first analytical method, I divided the number of sessions that the infants suckled for by the total number of sessions that I observed. I performed the same analysis for each nipple, and determined that changes in nipple preference depend on growth of the infants. For the second analysis, I counted the number of sessions in which the mothers were seen lying down on either the left or right side of their bodies, and subsequently divided the number by the total number of sessions. If the laterality is dependent on the mothers' posture, the rate of right nipple suckling should be higher when the mothers lie on their left side than on their right. Conversely, the rate of left nipple suckling should be higher when the mothers lie on their right side.

Results

Relation between infant age in days and nipple preference

Fig. 1 shows the change in nipple preference of the infants depending on their age in days. A more marked nipple preference was observed as the infants got older. Moreover, *Cooper* (Fig. 1b) and *Chonpe* (Fig. 1d) show significant laterality. According to *Chonpe's* graph, the rate at which this macaque chose the left nipple decreased to less than 10% at between 9 to 16 days of age. *Cooper* also showed a dramatic development of nipple preference between 4 to 18 days of age. These results suggest that nipple preference may be fixed between the ages of 10 to 15 days.

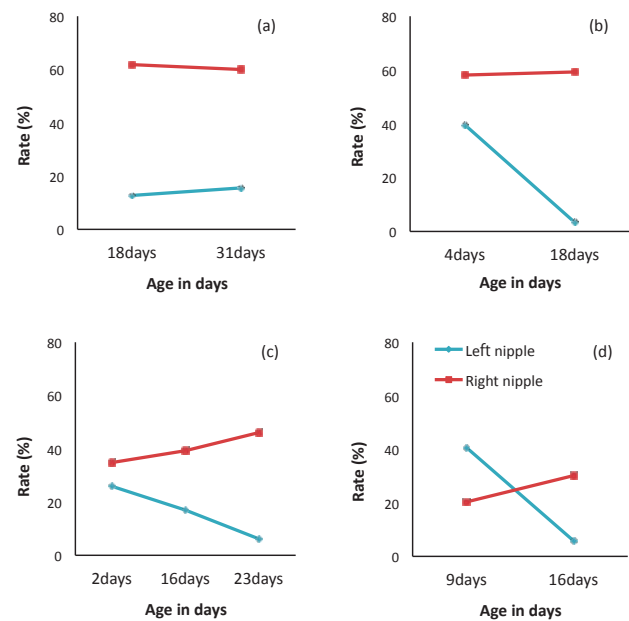


Fig. 1. Rate of nipple suckling according to infant age in days. (a) *Kusha-01* pair; (b) *Cooper-11* pair; (c) *Rakushi-06* pair; (d) *Chonpe-94* pair.

Relation between maternal posture and nipple preference

I observed no significant difference in laterality between the infants' nipple preference and the mothers' posture (Fig. 2). Laterality in nipple preference depending on the mother's posture was observed only for *Rakushi-06* and her infant (Fig. 2c). No other mother-infant pairs showed evidence of laterality. Other activities such as grooming and sitting occurred randomly, apparently, without evidence of regularity.

Discussion

My results suggest that nipple preference among Japanese macaque infants may be fixed at between 10 to 15 days of age regardless of their mothers' activity. My findings may indicate when nipple preference develops. Moreover, my results match those of previously reported studies which found that Japanese macaque infants suckle both

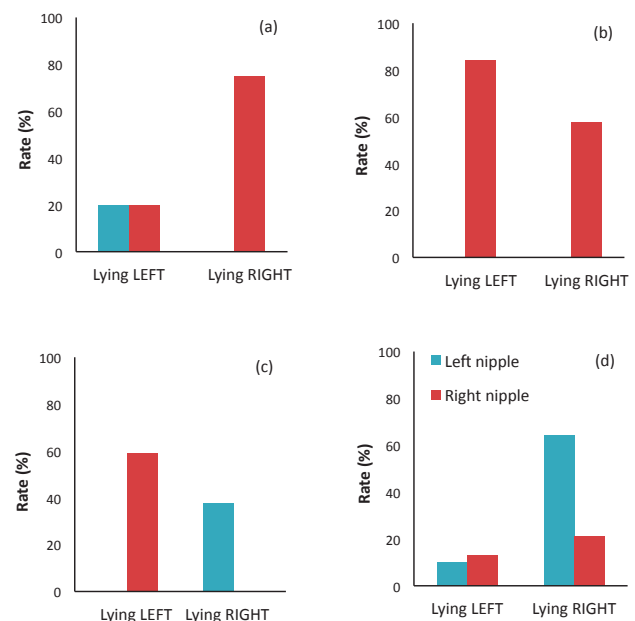


Fig. 2. Rate of nipple suckling according to maternal posture. (a) *Kusha-01* pair; (b) *Cooper-11* pair; (c) *Rakushi-06* pair; (d) *Chonpe-94* pair.

nipples until two weeks of age (7). Although the current study has indicated no relation between maternal activity and nipple preference, it is likely that both the mother and infant play an important role in nipple preference. One possibility is that the laterality of maternal milk secretion occurs without any known predetermination, and the infant subsequently becomes more likely to suckle the nipple that secretes more milk. And then, mothers might come to secrete more milk from one nipple, and nipple preference in suckling might be fixed gradually from between 10 to 15 age in days.

Nipple preference has no apparent correlation with any maternal activity as shown by the graphs in Figs. 1 and 2. Although I did not record which arm was used by the mothers to support their infants, according to a study done on chimpanzees, laterality in nipple preference is biased to the left and facilitated by the mothers' tendency to support their neonates with their left arm (1). Although Japanese macaque infants are able to hang and hold onto their mothers after about 10 days of age, they still require their mother's support to not fall. Further research is necessary to clarify the relation between nipple preference by infants and the hand that mothers use to support their infants among Japanese macaques.

In the course of my research, I obtained two conclusions by observing Japanese macaque mothers and infants. First, nipple preference is likely to depend on the infant age (in days) because infants are likely to suckle the nipple which offers more milk and therefore more nutrition. Second, there is no relation between nipple preference and macaque activities, such as moving, eating, grooming, sitting, and so on. However, some obstacles remain that prevent complete understanding of the phenomenon of nipple suckling laterality. Firstly, there is the problem of nutritional condition. The nutritional condition of a provisioned macaque is quite different from that of a wild macaque. This translates into a difference in the amount of milk yielded for their infants, which is a huge factor to consider. I should observe Japanese macaques in nature or collect mothers' milk from both wild and provisioned macaques to determine differences in their nutritional content.

I observed the macaques discontinuously for only a few days. That means that I may have missed potential relations between siblings. One study has reported an interesting finding that siblings prefer the nipple that was not used by their older sibling among rhesus macaques (3) and Japanese macaques (8). If I observe the Japanese macaque troop for 10 years or longer and continue recording mothers who have

borne two or more infants, new, interesting, and significant relations may be revealed.

Lastly, I should collect as much samples as we can of each mother's milk and check their nutritional content before comparing the difference between nipples. Moreover, a genetic approach is also necessary to determine if there is some genetic foundation for variations in nipple preference from mother to mother or from species to species.

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